REMARKS

The Applicants appreciate the thorough examination of the present application as evidenced by the Office Action of March 22, 2005. In response, the Applicants have amended Claims 1-9, 13-14, 16, 18-19, 28, 30-36, 40, 42, and 44 to more clearly define the claimed invention; and added new dependent Claims 53-58. The Applicants will also show in the following remarks that all claims are patentable over the cited art. Accordingly, the Applicants respectfully submit that all pending claims are in condition for allowance. A Notice of Allowance is thus respectfully requested in due course.

Independent Claims 1 And 28 Are Patentable Over Sawamura

Independent Claims 1 and 28 have been rejected under 35 U.S.C. Sec. 102(b) as being unpatentable over U.S. Patent No. 6,535,170 to Sawamura *et al.* ("Sawamura"). Claims 1 and 28 have been amended to clarify that the current null is present on the first conductive antenna segment between the feed and reference voltage couplings at the operating frequency band. Claims 1 and 28 are patentable for at least the reasons discussed below.

Claim 1, for example, recites a planar inverted F antenna configured for operation at an operating frequency band. The planar inverted F antenna of Claim 1 includes:

> first and second conductive antenna segments wherein the first and second conductive antenna segments are separated by at least approximately 3 mm;
> a third conductive antenna segment coupling the first and second conductive antenna segments;
> a reference voltage coupling on the first conductive antenna segment; and
> a feed coupling on the first conductive antenna segment, wherein a current null is present on the first conductive antenna segment between the feed and reference voltage couplings at the operating frequency band.

The Applicants respectfully submit that Swamura fails to teach or suggest a third conductive antenna segment coupling first and second conductive antenna segments, reference voltage and feed couplings on a same conductive antenna segment, and/or a current null on the conductive antenna segment between the reference voltage and feed couplings. In support of the rejection, the Office Action states that:

> Sawamura discloses a planar inverted F antenna configured for operation at an operating frequency band, the planar inverted F antenna comprising: first (12H) and second antenna segments (12L) wherein the first (2H) and second antenna (!2L)

> segments are separated by at least approximately 3mm; a third antenna segment (mark by examiner (12I) coupling the first (12H) and second antenna (12L) segments; a reference voltge (14) coupling on the first antenna segment; and a feed (13) coupling on the first antenna segment (12H), wherein a current null is present between the feed and reference voltage couplings at the operating frequency band. See figures 3D-3F, col. 6, lines 28-67 to col. 9, lines 1-22.

Office Action, page 2. Upon review of Sawamura, the Applicants respectfully submit that Sawamura does not teach at least a third antenna segment 12I coupling first and second antenna segments. As shown in Figures 3D and 3E of Sawamura, the antenna elements 12L and 12H are separate, and there is no third antenna segment 12I. Accordingly, Sawamura fails to teach or suggest a third antenna segment coupling first and second antenna segments.

Moreover, Figure 3D of Sawamura shows that the first power feed pin 13H is coupled to the antenna element 12H and the second power feed pin 13L is coupled to the antenna element 12L. Other than the power feed pins 13H and 13L, Sawamura does not show any couplings to either of the antenna elements 12H or 12L. Sawamura, thus, fails to teach or suggest two couplings on a same conductive antenna segment, much less a reference voltage coupling and a feed coupling on a same conductive antenna segment. Sawamura also fails to teach or suggest a current null between feed and reference voltage couplings all on a same conductive antenna segment.

Accordingly, the Applicants submit that Sawamura fails to teach or suggest the recitations of Claim 1, and that Claim 1 is thus patentable for at least these reasons. The Applicants further submit that Claim 28 is patentable over Sawamura for reasons similar to those discussed above with regard to Claim 1. In addition, Dependent Claims 2-13, 29-39, and 53-55 are patentable at least as per the patentability of Claim 1 from which they depend. If any rejections based on Sawamura should be maintained, the Applicants respectfully request that the Examiner point out portions of Sawamura that teach reference voltage and feed couplings on a same antenna segment and a current null therebetween.

Various Dependent Claims Are Separately Patentable Over Sawamura

Dependent Claims 2-13, 29-39, and 53-55 are patentable over Sawamura for the reasons discussed above with respect to Independent Claims 1 and 28 from which they depend. Various of these dependent claims are also separately patentable.

Dependent Claim 2, for example, depends from Claim 1 and thus includes all recitations of Claim 1 as discussed above. In addition, Claim 2 recites that the feed and reference voltage couplings are separated by at least approximately 15 mm. In support of the rejection, the Office Action states that Sawamura discloses that:

> the feed and reference voltage couplings are separated by at least approximately 15 mm. See figures 3D-3F.

Office Action, page 2. As discussed above, Sawamura discusses "first and second power feed pins 13H and 13L" (Sawamura, col. 7, lines 51-52), but Sawamura fails to teach or suggest a reference voltage coupling on a conductive antenna segment or pins 13H and 13L on a same conductive antenna segment. Moreover, even if power feed pins 13H and 13L could somehow be interpreted as reference voltage and feed couplings on a same conductive antenna segment, Sawamura fails to teach or suggest a separation of at least approximately 15 mm.

Accordingly, the Applicants respectfully submit that Dependent Claim 2 is separately patentable for at least these reasons. In addition, Dependent Claim 29 is separately patentable for reasons similar to those discussed above with regard to Claim 2. If the Examiner should maintain any rejection of Claims 2 and/or 29, the Applicants respectfully request that the Examiner point out portions of Sawamura that teach or suggest a separation of at least approximately 15 mm.

New Dependent Claim 53 depends from Claim 1 and thus includes all recitations discussed above with respect to Claim 1. In addition, Dependent Claim 54 recites that the operating frequency band is above 1700 MHz and that the current null is present between the feed and reference voltage couplings at the operating frequency band above 1700 MHz. With respect to operating frequencies, the Office Action states that:

> Sawamura discloses wherein the high frequency and is greater than 1700 MHz and wherein the low-frequency band is less than 1100 MHz. See figures 6A-6D, col. 9, lines 5-13.

Office Action, page 4. Nothing in Sawamura, however, teaches or suggests the presence of a current null between feed and reference voltage couplings, much less, the presence of such a current null at an operating frequency band above 1700 MHz.

Accordingly, the Applicants respectfully submit that Claim 53 is separately patentable over Sawamura for at least these reasons. In addition, the Applicants submit that Claims 8, 13,

35, 54, and 55 are separately patentable for reasons similar to those discussed above with respect to Claim 53. If any rejections should be maintained with respect to any of Claims 8, 13, 35, 53 54, and/or 55, the Applicants respectfully request that the Examiner identify portions of Sawamura that teach a current null between feed and reference voltage couplings at an operating frequency band above 1700 MHz.

Independent Claims 14 And 40 Are Patentable Over Boyle

Independent Claims 14 and 40 have been rejected under 35 U.S.C. Sec. 102(b) as being unpatentable over U.S. Patent Publication No. 2002/0130816 to Boyle ("Boyle"). Claims 14 and 40 have been amended to clarify that an electrical distance between a feed coupling and either of first and second reference voltage couplings is less than an electrical distance between the first and second reference voltage couplings.

As amended, Claim 14 recites a planar inverted F antenna including:

> a conductive antenna element;
> a feed coupling on the conductive antenna element; and
> first and second reference voltage couplings on the conductive antenna element wherein an electrical distance between the feed coupling and the first reference voltage coupling is less than an electrical distance between the first and second reference voltage couplings and wherein an electrical distance between the feed coupling and the second reference voltage coupling is less than the electrical distance between the first and second reference voltage couplings.

The Applicants respectfully submit that Boyle fails to teach or suggest a feed coupling and first and second reference voltage couplings on a same conductive antenna element.

Various planar inverted-F antenna (PIFA) structures are illustrated in Figures 1, 4, 7, 12, and 15 of Boyle. More particularly, the structures of Figures 1, 4, 7, 12, and 15 include rectangular patch conductor 102, a ground plane 104, a feed pin 106, and a shorting pin 108. More particularly:

> The antenna is fed via a feed pin 106, and connected to the ground plane 104 by a shorting pin 108.

Boyle, paragraph 33. As discussed with respect to Figure 4 of Boyle, the feed pin 106 may be fed by a voltage source 402 (*see* Bolyle, paragraph 35), and/or a voltage source 404 may provide

a voltage of V12 thereby generating respective currents in the pins 106, 108 (*see* Boyle, paragraph 36). In support of the rejection, the Office Action states that:

> Boyle discloses an antenna arrangement comprising a conductive antenna element (102), a feed coupling (106) on the conductive antenna element (102); and first (404) and second (404)reference voltage couplings on the conductive antenna element (102)....

Office Action, page 7.

The Applicants respectfully submit, however, that the voltage sources 404 of Boyle do not provide couplings on the patch conductor 102 apart from pins 106 and 108. Boyle, thus, fails to teach or suggest three couplings on a conductive antenna element, much less a feed coupling and first and second reference voltage couplings. Boyle further fails to teach or suggest an electrical distance between a feed coupling and a first reference voltage coupling being less than an electrical distance between first and second reference voltage couplings and an electrical distance between the feed coupling and the second reference voltage coupling being less than the electrical distance between the first and second reference voltage couplings.

Accordingly, the Applicants submit that Boyle fails to teach or suggest the recitations of Claim 14, and that Claim 14 is thus patentable for at least these reasons. The Applicants further submit that Claim 40 is patentable over Boyle for reasons similar to those discussed above with regard to Claim 14. In addition, Dependent Claims 15-27, 41-52, and 56-58 are patentable at least as per the patentability of Claims 14 and 40 from which they depend. If any rejections based on Boyle should be maintained, the Applicants respectfully request that the Examiner point out portions of Boyle that teach or suggests electrical distances between feed and reference voltage couplings as set forth in Claims 14 and 40.

Various Of The Dependent Claims Are Separately Patentable Over Boyle

Dependent Claims 15-27, 41-52, and 56-58 are patentable at least as per the patentability of Independent Claims 14 and 40 from which they depend. Various of these dependent claims are also separately patentable.

For example, Dependent Claim 15 depends from Claim 14 and thus includes all recitations of Claim 14 as discussed above. In addition, Claim 15 recites that the planar inverted F antenna is configured for operation at an operating frequency band and that a current null is present on the conductive antenna element between the feed coupling and at least one of the

reference voltage couplings at the operating frequency band. In support of the rejection, the Office Action states that Boyle discloses:

> wherein the planar inverted F antenna is configured for operation at an operating frequency band and wherein a current null is present on the conductive antenna element between the feed coupling and at least one of the reference voltage couplings at the operating frequency band. See figure 4.

Office Action, page 7. Boyle states that:

> Simulations were performed driving the feed and shorting pins 106, 108 (of equal diameter) in common and differential mode. FIG. 5 shows the simulated return loss S_{11} for frequencies f between 1000 and 3000 MHz, and FIG. 6 is a Smith chart showing the simulated impedance of the same frequency range.

Boyle, paragraph 46. Boyle, however, fails to teach or suggest a current null between the feed and shorting pins 106 and 108.

Accordingly, the Applicants respectfully submit that Claim 15 is separately patentable over Boyle for at least these reasons. In addition, Dependent Claim 41 is separately patentable over Boyle for reasons similar to those discussed above with regard to Claim 15. If the Examiner should maintain any rejection of Claims 15 and/or 41, the Applicants respectfully request that the Examiner point out portions of Boyle that teach or suggest a current null between feed and reference voltage couplings.

New Dependent Claim 56 depends from Claim 15, which in turn depends from Claim 14, and Claim 56 thus includes all recitations of Claims 14 and 15 as discussed above. In addition, Claim 56 recites that the operating frequency band is above 1700 MHz and that the current null is present between the feed coupling and at least one of the reference voltage couplings at the operating frequency band above 1700 MHz. With respect to operating frequencies, the Office Action states that:

> Boyle discloses wherein the operating frequency band is in the range of approximately 1700 MHz to 2500 MHz. See col. 3, lines [0046] to lines [0047].

Office Action, page 7. The cited portions of Boyle include a statement that:

> FIG. 5 shows the simulated return loss S_{11} for frequencies f between 1000 and 3000 MHz and FIG. 6 is a Smith chart showing the simulated impedance over the same frequency range.

Boyle, paragraph 46. Nothing in Boyle, however, teaches or suggests the presence of a current null between feed and reference voltage couplings, much less, the presence of such a current null at an operating frequency band above 1700 MHz.

Accordingly, the Applicants respectfully submit that Claim 56 is separately patentable over Boyle for at least these reasons. In addition, the Applicants submit that Claims 16, 18, 42, 57, and 58 are separately patentable for reasons similar to those discussed above with respect to Claim 56. If any rejections should be maintained with respect to any of Claims 16, 18, 42, 56, 57, and/or 58, the Applicants respectfully request that the Examiner identify portions of Boyle that teach a current null between feed and reference voltage couplings at an operating frequency band above 1700 MHz.

CONCLUSION

Accordingly, the Applicant submits that all pending claims in the present application are in condition for allowance, and a Notice of Allowance is respectfully requested in due course. The Examiner is encouraged to contact the undersigned attorney by telephone should any additional issues need to be addressed.

Respectfully submitted,

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I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to Mail Stop Amendment, Commissioner for Patents, P.O. Box 1340, Alexandria, VA 22313, on June 10, 2005.

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